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Cod Catch Results from Fall 1999 Survey in NAFO Division 3Ps

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Abstract

To enhance the fisheries research database in NAFO Division 3Ps, the Groundfish Enterprise Allocation Council (GEAC) has funded surveys during fall 1997, 1998, and 1999 directed at cod. The continuing intent is to create a series of annual fall surveys in 3Ps to complement current resource assessment activities carried out by the Department of Fisheries and Oceans (DFO). GEAC funded and performed the surveys with scientific guidance from DFO in the design and execution of a stratified random survey and the associated sampling. The data collected during these surveys have been subsequently analysed on behalf of GEAC and for the additional intent of providing this information to DFO, for their databases and their assessment work. This is the third such GEAC survey in 3Ps following on the 1997 and 1998 surveys (CSAS Research Documents 99/20, 99/34). One trip to perform the 1999 survey was carried out from 22 November to 2 December 1999. These dates match the 8-17 December 1997 and 30 November to 12 December 1998 time periods for the earlier two years. During the trip, set details and length frequencies were logged in the DFO FFS system and otoliths were collected for subsequent aging. Catch statistics, length and age distribution, and stratified analysis estimates of cod abundance and biomass, including age distribution estimates, and interpretation of results are presented. Results indicate the strengths of the 1992 to 1997 year classes are all up from the corresponding 1998 survey. The 1988 to 1990 year classes are down from the 1998 survey. Total abundance and biomass estimates for the 1999 survey are similar to those for 1998 which may suggest some form of stability in the stock.

Résumé

Afin d'enrichir la base de données de recherche sur les pêches pour la Division 3Ps de l'OPANO, le Conseil des allocations aux entreprises d'exploitation du poisson de fond (GEAC) a financé des relevés de la morue à l'automne 1997, 1998 et 1999. L'objectif est de mettre en œuvre une série de relevés annuels automnaux dans 3Ps, pour compléter les évaluations actuelles de la ressource faites par le ministère des Pêches et des Océans (MPO). Le GEAC a financé et réalisé les relevés, avec l'aide scientifique du MPO en ce qui concerne la conception et l'exécution des relevés suivant des techniques d'échantillonnage aléatoire stratifié ainsi que des échantillonnages connexes. Les données recueillies ont ensuite été analysées pour le compte du GEAC, également dans le but de transmettre les renseignements ainsi obtenus au MPO, qui l'inclura dans ses bases de données et l'utilisera pour ses travaux d'évaluation. Il s'agit du troisième relevé du genre du GEAC dans 3Ps, après ceux de 1997 et de 1998 (Documents de recherche du SCÉS 99/20, 99/34). Une sortie a été effectuée du 22 novembre au 2 décembre 1999 pour réaliser le relevé de 1999. Ces dates concordent avec les périodes du 8 au 17 décembre 1997 et du 30 novembre au 12 décembre 1998 au cours desquelles les sorties ont été effectuées les deux années précédentes. Pendant la sortie, des renseignements sur les stations et les fréquences de longueur ont été enregistrés dans le système FFS du MPO. Des otolithes ont aussi été prélevés pour déterminer l'âge des prises. Ce document présente des données sur les prises, la répartition de la taille et des âges, ainsi que des estimations à partir des analyses stratifiées de l'abondance et de la biomasse de la morue et de la répartition des âges, de même que l'interprétation des résultats. Les résultats indiquent que les indices des classes d'âge de 1992 à 1997 sont tous en hausse par rapport au relevé correspondant de 1998. Les classes d'âge de 1988 à 1990 sont à la baisse comparativement au relevé de 1998. Les estimations totales de l'abondance et de la biomasse à partir du relevé de 1999 sont semblables à celles de 1998, ce qui pourrait suggérer une certaine forme de stabilité dans le stock.

Introduction

To enhance the fisheries research database in NAFO Division 3Ps, the Groundfish Enterprise Allocation Council (GEAC) has funded surveys during fall 1997, 1998, and 1999 directed at cod. The continuing intent is to create a series of annual fall surveys in 3Ps to complement current resource assessment activities carried out by the Department of Fisheries and Oceans (DFO). GEAC funded and performed the surveys with scientific guidance from DFO in the design and execution of a stratified random survey and the associated sampling. The data collected during these surveys have been subsequently analysed on behalf of GEAC and for the additional intent of providing this information to DFO, for their databases and their assessment work. This is the third such GEAC survey in 3Ps following on the 1997 and 1998 surveys (CSAS Research Documents 99/20 [1], 99/34 [2]). Interest in this survey was directed both at cod and at american plaice and witch flounder. The 1999 results for the flatfish are presented in companion CSAS Research Documents 2000/025 [3], 2000/026 [4]. One trip to perform the 1999 survey was carried out from 22 November to 2 December 1999. These dates match the 8-17 December 1997 and 30 November to 12 December 1998 time periods for the earlier two years. During the trip, set details and length frequencies were logged in the DFO FFS system and otoliths were collected for subsequent aging.

Under contract to GEAC, AMEC (formerly AGRA Earth & Environmental) has taken the data logged using the DFO FFS system, combined with the aged otiliths, created digital data files appropriate for inclusion in the DFO (VAX computer system) databases, and performed a first analysis of the survey results. This document presents these results.

Methods and Materials

A Stratified Random survey was carried out in 3Ps by the *M.V. Pennysmart*. A summary of the trip is presented below.

Trip 4: Stratified Random Survey
Trip 4 was carried out from 22 November to 2 December 1999. This time period is consistent with the 1997 and 1998 random stratified survey sets. The *Pennysmart*, the same boat as in 1997/98 and with the same captain, sailed from Marystown for operation in 3Ps, St. Pierre Bank, Halibut Channel, and Green Bank. Figure 1 shows a map illustrating the location of the strata surveyed. The survey was directed at cod, american plaice, and witch flounder. Set details, length, sex, and otolith information were sampled. No significant weather or sea events were reported that would have adversely affected the trip success.

Tows of duration 30 minutes using an Engels 96 high lift trawl with a 135 mm diamond mesh cod end (not lined) were conducted. The trawl was fitted with rock hopper foot gear and Bergen #7 trawl doors. Performance of the trawl was

checked onboard using NETMIND sensors: bridge display of doorspread, wingspread, and net opening (headline height) was visually monitored and measurements were noted on the written bridge log for each set every five minutes. The trawl gear and configuration were identical to those used in the 1997 and 1998 surveys.

A total of 90 successful stratified random tow sets were completed. Four sets were unsuccessful.

Data were logged using FFS with the length and otolith sampling carried out on board. The resulting ages were input to create an age and growth digital file.

Results and Discussion

Shore-based Analysis

The set details and cod length frequencies were exported from FFS to create ASCII data files. The age and growth data were keyed in following completion of the otolith aging by Norm Batten (otolith reader for 1997 and 1998 as well). The sole focus in the work presented here is for cod.

The cod were sampled in 1 cm length groupings and all ratio/percentages of catch measured were applied.

ACON plots of the spatial distribution of catch numbers and weights were carried out. These are presented in Figures 2a and 2b. Table 1 presents a summary of the cod set details and catch numbers and weights.

The mean cod catch for the 90 stratified random sets is 25 fish and a mean catch weight of 85 kg. A catch of cod was reported in 67 of the 90 successful sets. The largest catch of 753 cod and weight 2553 kg was from set 75 in the Halibut Channel at a depth of approximately 220 m. A total of 10 sets had catches over 100 kg, four sets with catches over 200 kg. The mean cod weight for all sets (total weight/total numbers) was 3.4 kg per cod. The median cod weight of the 67 sets in which cod were caught was 2.5 kg. The mean weight for the largest catch set 75 was 3.4 kg.

Gear Performance

The NETMIND wing sensor was lost initially when the tow gear fouled. The ship returned to Marystown for a replacement sensor and repaired the gear. There are no wings values for sets 1 to 18. There are also no measurements for opening for sets 78 onwards.

For the reported sets, doorspread exhibited a large range of values varying from 50 to just under 100 m, generally increasing in value with depth (Figure 3d). Wingspread was fairly uniform with a mean value of 18.5 m (Figure 3a). This wingspread value is consistent with the 1998 NETMIND mean wingspread value

and that used in the 1997 survey. Some net parameter measurements were collected by a SCANMAR system in 1997; however, that system performed with some problems in the later sets. No wingspread data are available from that 1997 survey: the 1997 best estimate of 60 feet has been used for the all stratified analysis to date. Figures 3b and 3c present trawl depth and bottom temperature for each set. The values are gleaned from the set sheets.

Figure 4 presents the length composition of the 1999 survey and, for comparison, results from the 1997 and 1998 surveys are also shown. For 1999, the fish range in size between less than 35 cm up to 113 cm (from set 76 – the second largest cod set). The distribution shows a broad peak in the 60 to 75 cm range, similar to that for 1997 although the peak in 1999 is shifted slightly to greater lengths. The 1999 peak is the most well-defined and prominent of the three years. As in 1997, the distribution falls off steadily after 70 to 80 cm unlike that exhibited in 1998 in which a second peak exists at 88 cm and extends between 82 to 95 cm. Conversely, while for 1998 there is a peak near 62-65 cm and extending between about 55 and 73 cm, the percent occurrence of those lengths are less than for 1997 and 1999. Nearly one half (47.7%) of all sampled cod for 1998 had lengths greater than 80 cm. By comparison the corresponding values are only 13.7% for 1999 and 10.3% for 1997.

Figures 5a to 5c present age composition of the 1999 sampled cod. Figure 5a presents length versus age distribution. Figures 5b and 5c present bar charts of the sampled numbers and percent occurrence of cod at age, including the 1997 and 1998 results. A total of 551 otoliths were taken, a comparable number to the 502 in 1997 and 450 in 1998. The oldest cod was 13 (a male of length 83 cm from set 77) with four of age 12, eight of age 11, and 64 of age 10 also recorded. The 1999 survey shows significantly more fish at age 10 than in the other two years. In fact, all ages between 2 and 10 are generally well-represented compared to 1997 and 1998 except for age 8 – the weak 1991 year class. The number of age 4 and age 5 fish are about 25 to 30% fewer than for 1998: age 3 cod for 1999 are double those sampled in 1998. The sampled numbers of the 1990 year class in 1998 (age 8) are down slightly by 15% in 1999 (age 9). The difference in 1989 year class is more dramatic: samples in 1999 (age 10) are down by about 40% from the corresponding age 9 samples in 1998.

Stratified Random surveys analysis was carried out using the DFO stratified analysis STRAP software and applying the French Exclusion Zone around St. Pierre et Miquelon for area calculations. A wingspread of 60 feet was used. Table 2a presents the STRAP output of estimated abundance and biomass. The estimated total number of cod for 3Ps is 13.7 million (with 95% confidence limits of 6.7 and 20.7 million). The mean number of cod per standard 1.5 nautical mile tow is 16.5 (with limits of 8.1 and 24.9 fish). The estimated total cod biomass is 44.5 ktonnes (with limits of 27.3 and 61.7 ktonnes). The mean catch weight per tow is 53.5 kg (with limits of 32.9 and 74.1 kg). Table 2b presents a summary comparison of

abundance and biomass STRAP estimates for 1997 to 1999. The 1999 and 1998 values are generally consistent. The total estimated numbers of fish are up 30% from 1998, while the biomass estimates are down 7% from 1998. Comparing 1999 and 1997, the total estimated numbers of fish for 1999 are down by 55% from 1997. The estimated number of fish per set are down by 69%. The 1999 total estimated biomass is 45% that of 1997. The estimated mean catch per tow is 32% of that estimated from the 1997 survey.

Table 3a presents the STRAP age composition of numbers per tow, with sexes combined. The total mean number per tow is 16.5 (consistent with the value in Table 2a, smaller than the mean of 24.9 in Table 1), with the greatest numbers expected at ages 6 (3.57 fish per tow), 7 (3.32 fish), and 5 (2.79 fish).

Tables 4a and 4b present the cod abundance and biomass estimates by strata for 1997 to 1999, arranged by depth regime. There appears to be a general consistency in the numbers reported for each depth regime. Two large catch sets from the 1997 survey in stratum 319 accounted for approximately 50% and 42% of the 1997 survey total catch numbers and weights respectively. If one removes the strata 319 estimates for all years in Table 4a, the 1997 and 1999 totals now fall within 5% of one another: corresponding (Table 4b) biomass estimates are now within 22% for 1997 and 1999. The presence of several large catch sets can greatly affect overall totals meanwhile results in the other strata and depth regimes may continue to show and suggest more consistency.

Figure 6b presents the STRAP-estimated percent occurrence of mean catch numbers per tow. The percent occurrence of age 4, 5 and 8 cod decrease steadily from 1997 to 1998 to 1999. The 1999 estimates for ages 6 and 7 are the greatest in the three years.

Figures 7a and 7b present age composition by year class as opposed to age. In 1997, the strongest year classes were 1992, 1989, and 1990 and 1993. In 1998, the strongest year classes were 1989, 1993, and 1994, 1992, and 1990 . In 1999, the strongest year classes were 1993, 1992, and 1994. The 1991 year class is weak in all years. The estimated numbers for the 1989 and 1990 year class, strong in the 1997 and 1998 surveys, are in 1999, 25 to 50% or even more reduced. The estimated 1989 year class numbers increase from 22% in 1997 to 27% in 1998, and then decrease to 8% in 1999. On the other hand, 1999 has the greatest proportion of year classes 1995 through 1993, and the 1992 year class estimates are up 6% from 14% in 1998 to 20% in 1999.

Tables 3b and 3c present year class and age summary comparisons of abundance STRAP estimates for 1997 to 1999. The 1999 values are those from Table 3a. A large range of year classes is evident for 1999. Consistent with the Figure 7 results discussed above, the 1999 survey indicates the 1991 through 1996 year classes are up from 1998. The 1989 year class shows the greatest decline since 1998.

While the 1999 survey indicates fewer cod than 1998 for each age 8 and older, there are more cod per age for ages 7 and younger.

The results indicate that the strengths of a range of year classes, those for 1992 to 1997, are all increased from the corresponding 1998 survey. The 1988 to 1990 year classes are down from the 1998 survey. Total abundance and biomass estimates for the 1999 survey are similar to those for 1998 which may suggest some form of stability in the stock.

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Table 1 Summary of Cod Catches for Stratified Random Survey Sets, NAFO Division 3Ps, 22 Nov - 2 Dec 1999.

M.V. Pennysmart								Unit	Set Location		Catch	COD Catch	Set Duration	Tow Distance	COD Mean
Vessel	Trip	Set	Year	Month	Day	StrLin	Division	Area	Lat (N)	Long (W)	# of Fish	Weight (kg)	(min)	(n.mi.)	Weight (kg)
49	4	1	99	11	22	322	3P	M29	46.56	55.93	0	0.0	30	1.5	
49	4	2	99	11	23	322	3P	M30	46.40	55.90	1	2.0	30	1.5	2.0
49	4	3	99	11	23	322	3P	M30	46.44	55.70	5	9.5	30	1.6	1.9
49	4	4	99	11	23	322	3P	M30	46.32	55.54	0	0.0	30	1.6	
49	4	5	99	11	23	321	3P	M30	46.17	55.53	1	0.5	20	1	0.5
49	4	6	99	11	23	321	3P	M30	46.11	55.59	6	32.0	30	1.6	5.3
49	4	7	99	11	23	321	3P	M30	46.20	55.68	4	14.5	30	1.5	3.6
49	4	8	99	11	23	322	3P	M30	46.29	55.88	8	9.5	30	1.5	1.2
49	4	9	99	11	23	322	3P	L30	46.36	56.10	2	4.3	30	1.5	2.1
49	4	10	99	11	23	320	3P	L30	46.06	56.45	54	139.0	30	1.5	2.6
49	4	11	99	11	23	320	3P	L30	46.08	56.61	50	137.0	30	1.5	2.7
49	4	12	99	11	23	314	3P	L30	46.12	56.49	1	3.5	30	1.6	3.5
49	4	13	99	11	23	314	3P	L30	46.29	56.89	3	1.5	30	1.4	0.5
49	4	14	99	11	23	314	3P	L30	46.37	57.00	1	7.0	30	1.5	7.0
49	4	16	99	11	24	314	3P	K29	46.50	57.01	2	3.0	30	1.5	1.5
49	4	17	99	11	24	314	3P	L29	46.68	56.99	4	5.0	30	1.5	1.3
49	4	19	99	11	24	311	3P	K29	46.80	57.12	11	20.5	30	1.4	1.9
49	4	20	99	11	24	310	3P	K29	46.92	57.09	11	27.0	30	1.5	2.5
49	4	21	99	11	24	310	3P	K29	46.83	57.33	18	42.5	30	1.5	2.4
49	4	22	99	11	24	313	3P	K29	46.73	57.39	181	427.0	30	1.5	2.4
49	4	23	99	11	24	313	3P	K29	46.62	57.51	8	16.0	30	1.5	2.0
49	4	24	99	11	24	713	3P	K30	46.48	57.64	0	0.0	30	1.5	
49	4	25	99	11	24	713	3P	J30	46.24	58.06	0	0.0	30	1.4	
49	4	26	99	11	24	713	3P	K30	46.10	57.91	0	0.0	30	1.5	
49	4	27	99	11	25	713	3P	K30	46.02	57.78	0	0.0	29	1.4	
49	4	28	99	11	25	713	3P	K30	46.12	57.46	0	0.0	30	1.5	
49	4	29	99	11	25	713	3P	K30	46.32	57.50	0	0.0	30	1.5	
49	4	30	99	11	25	705	3P	K30	46.37	57.46	0	0.0	30	1.5	
49	4	32	99	11	25	312	3P	K30	46.29	57.21	37	83.0	30	1.5	2.2
49	4	33	99	11	25	312	3P	K30	46.16	57.06	6	13.0	30	1.6	2.2
49	4	35	99	11	26	322	3P	M30	46.34	55.40	3	4.0	30	1.5	1.3
49	4	36	99	11	26	323	3P	M30	46.03	55.36	1	2.5	30	1.6	2.5
49	4	37	99	11	26	321	3P	M30	46.00	55.43	2	2.5	30	1.6	1.3
49	4	38	99	11	26	321	3P	M31	45.79	55.64	3	12.0	30	1.6	4.0
49	4	39	99	11	26	320	3P	M31	45.83	55.83	48	127.0	30	1.5	2.6
49	4	40	99	11	26	320	3P	L31	45.82	56.13	8	21.0	30	1.4	2.6

Table 1 (continued) Summary of Cod Catches for Stratified Random Survey Sets, NAFO Division 3Ps, 22 Nov - 2 Dec 1999.

M.V. Pennysmart Vessel	Trip	Set	Year	Month	Day	StrLin	Division	Unit Area	Set Location Lat (N)	Set Location Long (W)	Catch # of Fish	COD Catch Weight (kg)	Set Duration (min)	Tow Distance (n.mi.)	COD Mean Weight (kg)
49	4	41	99	11	26	320	3P	L31	45.65	56.07	23	77.0	30	1.5	3.3
49	4	42	99	11	26	321	3P	M31	45.66	55.63	6	32.0	30	1.5	5.3
49	4	43	99	11	26	323	3P	M31	45.62	55.23	0	0.0	26	1.4	
49	4	44	99	11	26	315	3P	M32	45.43	55.51	227	785.0	30	1.5	3.5
49	4	45	99	11	27	320	3P	M32	45.46	55.78	3	8.0	30	1.5	2.7
49	4	46	99	11	27	320	3P	L32	45.42	56.05	1	2.5	30	1.7	2.5
49	4	47	99	11	27	315	3P	L31	45.52	56.44	67	183.5	30	1.6	2.7
49	4	48	99	11	27	316	3P	L31	45.59	56.59	6	19.0	30	1.4	3.2
49	4	49	99	11	27	315	3P	L31	45.63	56.46	17	75.0	30	1.5	4.4
49	4	50	99	11	27	317	3P	L31	45.72	56.66	5	12.0	30	1.6	2.4
49	4	51	99	11	27	706	3P	M31	45.72	55.93	0	0.0	30	1.5	
49	4	52	99	11	27	311	3P	K30	46.17	57.12	4	10.0	30	1.5	2.5
49	4	53	99	11	27	705	3P	K30	46.04	57.18	0	0.0	30	1.5	
49	4	54	99	11	27	712	3P	K31	45.74	57.11	0	0.0	30	1.5	
49	4	55	99	11	28	712	3P	K31	45.62	57.20	0	0.0	30	1.3	
49	4	56	99	11	28	712	3P	L31	45.51	56.80	0	0.0	30	1.6	
49	4	57	99	11	28	706	3P	L32	45.44	56.56	0	0.0	30	1.5	
49	4	58	99	11	28	706	3P	L32	45.30	56.43	1	3.5	30	1.5	3.5
49	4	59	99	11	29	322	3P	M30	46.42	55.07	2	2.0	30	1.6	1.0
49	4	60	99	11	29	323	3P	M30	46.14	55.02	1	1.0	30	1.6	1.0
49	4	61	99	11	29	323	3P	N30	46.13	54.85	0	0.0	30	1.4	
49	4	62	99	11	29	323	3P	N31	45.98	54.94	0	0.0	30	1.5	
49	4	63	99	11	29	325	3P	N31	45.75	54.82	0	0.0	30	1.5	
49	4	64	99	11	29	325	3P	N31	45.74	54.98	0	0.0	30	1.5	
49	4	65	99	11	29	319	3P	M31	45.52	55.05	8	11.5	30	1.5	1.4
49	4	66	99	11	29	319	3P	M32	45.44	55.22	11	42.0	30	1.7	3.8
49	4	67	99	11	29	319	3P	M32	45.25	55.30	8	40.0	30	1.5	5.0
49	4	68	99	11	29	319	3P	M32	45.23	55.31	9	29.0	30	1.5	3.2
49	4	69	99	11	29	315	3P	M32	45.25	55.95	4	23.0	30	1.5	5.8
49	4	70	99	11	29	315	3P	L32	45.11	56.09	15	38.0	30	1.4	2.5
49	4	71	99	11	30	317	3P	L32	45.00	56.09	17	46.5	30	1.5	2.7
49	4	72	99	11	30	316	3P	L33	44.92	56.01	10	32.0	30	1.5	3.2
49	4	73	99	11	30	707	3P	M33	44.89	55.76	8	22.0	30	1.5	2.8
49	4	74	99	11	30	708	3P	M33	44.95	55.55	4	6.8	30	1.5	1.7
49	4	75	99	11	30	318	3P	M32	45.06	55.43	753	2552.7	30	1.5	3.4
49	4	76	99	11	30	318	3P	M32	45.11	55.24	385	1936.5	30	1.5	5.0

Table 1 (continued) Summary of Cod Catches for Stratified Random Survey Sets, NAFO Division 3Ps, 22 Nov - 2 Dec 1999.

M.V. Pennysmart Vessel	Trip	Set	Year	Month	Day	StrLin	Division	Unit Area	Set Location Lat (N)	Set Location Long (W)	Catch # of Fish	COD Catch Weight (kg)	Set Duration (min)	Tow Distance (n.mi.)	COD Mean Weight (kg)
49	4	77	99	11	30	707	3P	M32	45.05	55.23	50	175.5	30	1.6	3.5
49	4	78	99	11	30	319	3P	M32	45.19	55.05	15	43.0	30	1.5	2.9
49	4	79	99	11	30	319	3P	N32	45.20	54.81	4	6.0	30	3	1.5
49	4	80	99	11	30	708	3P	N32	45.00	54.58	0	0.0	30	1.4	
49	4	81	99	12	1	325	3P	N32	45.35	54.70	3	8.0	30	1.6	2.7
49	4	82	99	12	1	325	3P	N31	45.56	54.77	1	2.0	30	1.4	2.0
49	4	83	99	12	1	325	3P	N31	45.55	54.70	0	0.0	30	1.5	
49	4	84	99	12	1	326	3P	N31	45.77	54.43	1	0.4	30	1.6	0.4
49	4	85	99	12	1	326	3P	N31	45.82	54.38	0	0.0	30	1.5	
49	4	86	99	12	1	325	3P	N30	46.03	54.51	1	1.0	30	1.5	1.0
49	4	87	99	12	1	324	3P	N30	46.28	54.62	3	1.3	30	1.5	0.4
49	4	88	99	12	1	324	3P	N29	46.53	54.61	1	0.3	30	1.5	0.3
49	4	89	99	12	1	324	3P	N29	46.61	54.58	5	5.5	30	1.5	1.1
49	4	90	99	12	2	322	3P	M30	46.44	55.12	3	2.0	30	1.3	0.7
49	4	91	99	12	2	321	3P	M30	46.11	55.98	2	0.8	30	1.5	0.4
49	4	92	99	12	2	320	3P	L31	45.93	56.08	4	15.0	30	1.5	3.8
49	4	93	99	12	2	315	3P	M31	45.56	55.48	35	101.0	30	1.5	2.9
49	4	94	99	12	2	319	3P	M31	45.52	55.37	36	95.0	30	1.5	2.6
								Minimum			0.0	0.0	20.0	1.0	0.3
								Maximum			753.00	2552.66	30.00	3.00	7.00
								Mean			24.87	84.59	29.83	1.52	3.40
								Median			3.00	5.75	30.00	1.50	2.50
								Standard Error			1.03	3.83	0.01	0.00	0.02
								Total			2238.00	7613.41	2685.00	136.50	170.22
								Count			90	90	90	90	67

Table 2a Stratified Analysis Estimated Cod Abundance and Biomass

COD GEAC 3PS 1999 No Zone
ANALYSIS FOR TRIP 4 1999 VESSEL 49 ICNAF 3P SPECIES 0438

NUMBERS

STRATUM	NO.SETS	TOTAL	AV./SET	UNITS	TOTAL NO	VAR.
310	2	29.00	14.50	9255.	134204.	24.50
311	2	15.79	7.89	17903.	141304.	30.31
312	2	42.63	21.31	16281.	346998.	492.20
313	2	189.00	94.50	11147.	1053395.	14964.50
314	5	11.15	2.23	61748.	137720.	1.83
315	6	361.88	60.31	52357.	3157877.	7087.21
316	2	16.43	8.21	11147.	91565.	6.38
317	2	21.69	10.84	11620.	126004.	75.80
318	2	1138.00	569.00	8715.	4958809.	67712.00
319	7	87.71	12.53	66477.	832916.	121.55
320	8	191.45	23.93	79988.	1914260.	538.06
321	7	23.81	3.40	73503.	250041.	3.39
322	9	24.02	2.67	94648.	252649.	6.42
323	5	1.88	0.38	47020.	17633.	0.26
324	3	9.00	3.00	33374.	100121.	4.00
325	6	4.88	0.81	63775.	51912.	1.22
326	2	0.94	0.47	11215.	5257.	0.44
705	2	0.00	0.00	13174.	0.	0.00
706	3	1.00	0.33	28509.	9503.	0.33
707	2	54.88	27.44	4999.	137168.	755.63
708	2	4.00	2.00	8512.	17025.	8.00
712	3	0.00	0.00	49385.	0.	0.00
713	6	0.00	0.00	57492.	0.	0.00

	TOTAL			AVERAGE	
TOTAL	UPPER	LOWER	MEAN	UPPER	LOWER
13736357.	20702178.	6770538.	16.51	24.88	8.14

EFFECTIVE DEGREES OF FREEDOM= 5 STUDENTS T-VALUE= 2.57 ALPHA=0.05

WEIGHTS

STRATUM	NO.SETS	TOTAL	AV./SET	UNITS	TOTAL NO	VAR.
310	2	69.50	34.75	9255.	321626.	120.13
311	2	31.96	15.98	17903.	286125.	71.57
312	2	95.19	47.59	16281.	774894.	2507.21
313	2	443.00	221.50	11147.	2469068.	84460.50
314	5	19.89	3.98	61748.	245613.	4.31
315	6	1196.75	199.46	52357.	10443056.	85026.48
316	2	52.36	26.18	11147.	291813.	67.78
317	2	57.75	28.88	11620.	335526.	621.28
318	2	4489.17	2244.58	8715.	19561452.	189820.34
319	7	258.56	36.94	66477.	2455454.	879.87
320	8	527.71	65.96	79988.	5276294.	3734.13
321	7	91.64	13.09	73503.	962297.	177.95
322	9	32.84	3.65	94648.	345351.	12.08
323	5	3.28	0.66	47020.	30857.	1.05
324	3	7.05	2.35	33374.	78428.	7.67
325	6	10.64	1.77	63775.	113124.	8.59
326	2	0.38	0.19	11215.	2103.	0.07
705	2	0.00	0.00	13174.	0.	0.00
706	3	3.50	1.17	28509.	33261.	4.08
707	2	186.53	93.27	4999.	466261.	10157.58
708	2	6.75	3.38	8512.	28729.	22.78
712	3	0.00	0.00	49385.	0.	0.00
713	6	0.00	0.00	57492.	0.	0.00

	TOTAL			AVERAGE	
TOTAL	UPPER	LOWER	MEAN	UPPER	LOWER
44521332.	61704448.	27338222.	53.50	74.14	32.85

EFFECTIVE DEGREES OF FREEDOM= 8 STUDENTS T-VALUE= 2.31 ALPHA=0.05

Table 2b Stratified Analysis Estimated Cod Abundance and Biomass: Comparison for 1997-1999

3Ps Cod Estimates						
"numbers"abundance (millions of fish)						
	95% upper limit	Estimated	95% lower limit	95% upper limit	Mean #fish /tow	95% lower limit
1997	57.1	30.9	4.8	97	52.6	8.2
1998 **	11.9	10.5	9.1	14	12.6	11
1999	20.7	13.7	6.7	24.9	16.5	8.1
"weights" biomass (ktonnes)						
	95% upper limit	estimated	95% lower limit	95% upper limit	Mean catch /tow (kg)	95% lower limit
1997	174.2	99.3	24.4	296	169	41
1998 **	56.8	47.9	38.9	68.3	57.5	46.8
1999	61.7	44.5	27.3	74.1	53.5	32.9
** 75% upper and lower limits reported for 1998						

Table 3a Stratified Analysis Cod Age Composition, Numbers per Standard Tow

COD GEAC 1999 3PS No Zone (S1 BY AGE)
ANALYSIS FOR TRIP 4 1999
VESSEL 49
ICNAF 3P

AGE COMPOSITION-NUMBERS PER STANDARD TOW

SUMMARY TABLE
SPECIES:SPECIES 0438
SEX:COMBINED

SEX:COMBINED

AGE IN YEARS	TOTAL NUMBERS	UPPER LIMIT	LOWER LIMIT	MEAN PER TOW	UPPER LIMIT	LOWER LIMIT	D.F.
0.0	0.	0.	0.	0.00	0.00	0.00	0
1.0	0.	0.	0.	0.00	0.00	0.00	0
2.0	284031.	375834.	192228.	0.34	0.45	0.23	32
3.0	950367.	1302701.	598033.	1.14	1.57	0.72	9
4.0	1425300.	2526139.	324462.	1.71	3.04	0.39	3
5.0	2352948.	4861474.	-155579.	2.83	5.84	-0.19	2
6.0	2975684.	5204508.	746859.	3.58	6.25	0.90	4
7.0	2724708.	4557759.	891657.	3.27	5.48	1.07	5
8.0	427966.	707930.	148001.	0.51	0.85	0.18	5
9.0	1188439.	1779439.	597439.	1.43	2.14	0.72	6
10.0	1132576.	1515670.	749482.	1.36	1.82	0.90	7
11.0	138741.	527104.	-249623.	0.17	0.63	-0.30	1
12.0	81966.	603555.	-439624.	0.10	0.73	-0.53	1
13.0	14120.	27014.	1226.	0.02	0.03	0.00	3
UNKNOWN	39217.	537425.	-458990.	0.05	0.65	-0.55	1
TOTAL	13736062.	20704784.	6767341.	16.50	24.88	8.13	5

ESTIMATION TYPE:STANDARD TRANSFORMATION TYPE:NONE
CONFIDENCE LEVEL: 0.95%
****-ONE OR MORE OF THE LOWER LIMITS IN THE ABOVE
TABLE IS LESS THAN OR EQUAL TO ZERO. VARIANCE IS TOO LARGE FOR VALID CONFIDENCE LIMITS ****

Table 3b Stratified Analysis Estimated Cod Abundance Year Class Distribution: Comparison for 1997-1999

	3Ps Cod Estimates					
	"number" abundance (millions of fish)			Mean #fish/tow		
Year Class	1997	1998	1999	1997	1998	1999
1996	0.00	0.05	0.94	0.00	0.06	1.14
1995	0.17	0.33	1.46	0.29	0.40	1.71
1994	1.93	1.47	2.32	3.28	1.76	2.83
1993	5.55	1.93	2.97	9.42	2.32	3.58
1992	8.02	1.51	2.76	13.62	1.81	3.27
1991	1.78	0.29	0.44	3.02	0.35	0.51
1990	5.91	1.36	1.18	10.03	1.64	1.43
1989	7.05	2.83	1.10	11.97	3.40	1.36
1988	0.79	0.33	0.15	1.34	0.40	0.17
1987	0.32	0.04	0.07	0.54	0.04	0.10
1986	0.14	0.11	0.01	0.24	0.13	0.02

Table 3c Stratified Analysis Estimated Cod Abundance Age Distribution: Comparison for 1997-1999

	3Ps Cod Estimates					
	"number" abundance (millions of fish)			Mean #fish/tow		
Age (years)	1997	1998	1999	1997	1998	1999
1	0.00	0.01	0.00	0.00	0.01	0.00
2	0.17	0.05	0.28	0.29	0.06	0.34
3	1.93	0.33	0.94	3.28	0.40	1.14
4	5.55	1.47	1.46	9.42	1.76	1.71
5	8.02	1.93	2.32	13.62	2.32	2.83
6	1.78	1.51	2.97	3.02	1.81	3.58
7	5.91	0.29	2.76	10.03	0.35	3.27
8	7.05	1.36	0.44	11.97	1.64	0.51
9	0.79	2.83	1.18	1.34	3.40	1.43
10	0.32	0.33	1.10	0.54	0.40	1.36
11	0.14	0.04	0.15	0.24	0.04	0.17
12	0.02	0.11	0.07	0.04	0.13	0.10
13		0.18	0.01		0.22	0.02

Table 4a Cod abundance estimates (thousands of fish) from GEAC surveys in NAFO Division 3Ps from 1997-1999

Depth range (fathoms)	Strata	Vessel Trip #Sets Mean Date sq. mi.	Pennysmart 2 84 12-Dec 1997	Pennysmart 3 86 6-Dec 1998	Pennysmart 4 90 27-Nov 1999
<30	314	974	86	1111	138
	320	1320	4004	1540	1914
		Subtotal	4090	2651	2052
31-50	312	272	725	33	347
	315	827	2046	1456	3158
	321	1189	175	189	250
	325	944	50	11	52
	326	166	17	0	5
		Subtotal	3013	1689	3812
51-100	311	317	832	63	141
	317	193	226	331	126
	319	984	17410	370	833
	322	1567	.	95	253
	323	696	225	47	18
	324	494	.	78	100
		Subtotal	18693	984	1471
101-150	310	170	150	699	134
	313	165	443	167	1053
	316	189	3606	312	92
	318	129	339	3736	4959
		Subtotal	4538	4914	6238
151-200	705	195	103	7	0
	706	476	513	29	10
	707	74	29	180	137
		Subtotal	645	216	147
201-300	708	126	.	9	17
	712	731	.	0	0
	713	851	.	19	0
		Subtotal	0	28	17
	Total [1]		30,979	10,482	13,737

[1] Totals are for all strata fished. Individual strata totals rounded to nearest 1000.
. denotes strata not fished

Table 4b Cod biomass estimates (t) from GEAC surveys in NAFO Division 3Ps from 1997-1999

Depth range (fathoms)	Strata	Vessel Trip #Sets Mean Date sq. mi.	Pennysmart 2 84 12-Dec 1997	Pennysmart 3 86 6-Dec 1998	Pennysmart 4 90 27-Nov 1999
<30	314	974	262	7464	246
	320	1320	18907	5287	5276
		Subtotal	19169	12751	5522
31-50	312	272	1215	138	775
	315	827	11171	4071	10443
	321	1189	301	559	962
	325	944	89	55	113
	326	166	36	0	2
		Subtotal	12812	4823	12295
51-100	311	317	1558	120	286
	317	193	957	938	336
	319	984	48133	1255	2455
	322	1567	.	149	345
	323	696	341	103	31
	324	494	.	174	78
		Subtotal	50989	2739	3531
101-150	310	170	263	1823	322
	313	165	1132	458	2469
	316	189	12362	803	292
	318	129	911	23797	19561
		Subtotal	14668	26881	22644
151-200	705	195	277	11	0
	706	476	1317	118	33
	707	74	96	480	466
		Subtotal	1690	609	499
201-300	708	126	.	16	29
	712	731	.	0	0
	713	851	.	57	0
		Subtotal	0	73	29
	Total [1]		99,328	47,876	44,520

[1] Totals are for all strata fished. Individual strata totals rounded to nearest 1000.
. denotes strata not fished

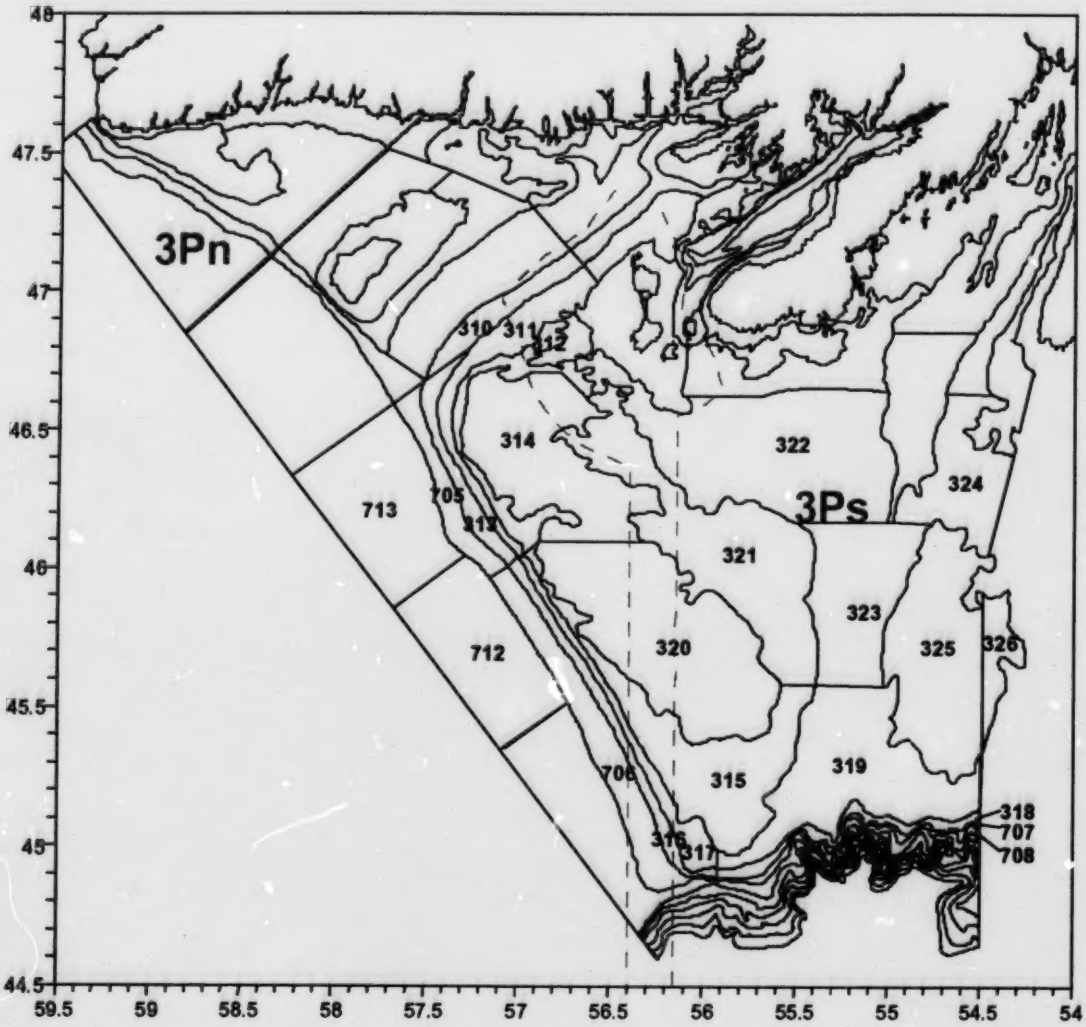

Figure 1 Stratum boundaries within NAFO Division 3P. Numbered strata indicate those surveyed during fall GEAC bottom trawl survey of Subdivision 3Ps. Dashed line is boundary of French economic zone which was not surveyed.

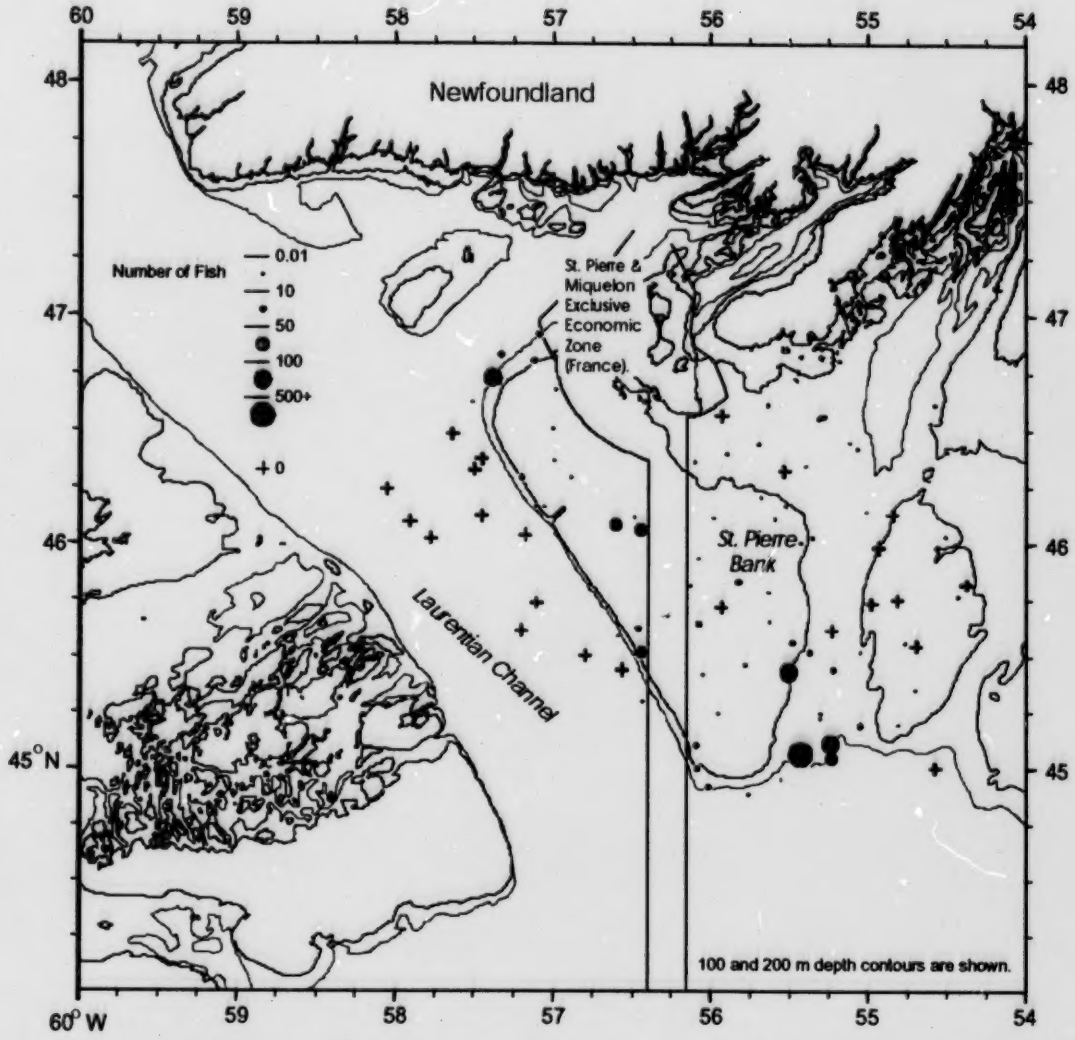

Figure 2a Cod Catch Distribution: Number of Fish, from Pennysmart Trip #4 Random Stratified Surveys, NAFO Division 3Ps, 22 Nov to 2 Dec 1999.

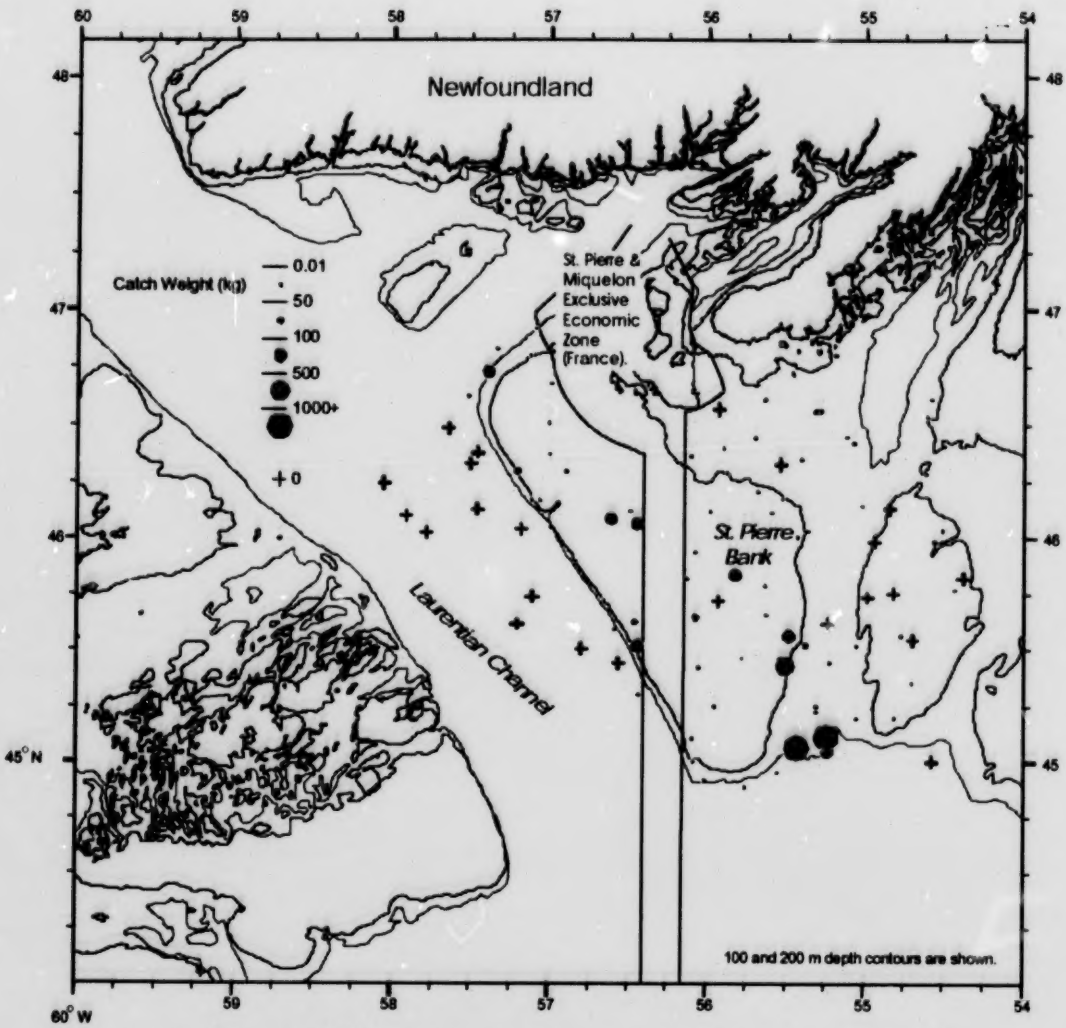

Figure 2b Cod Catch Distribution: Catch Weight, from Pennysmart Trip #4 Random Stratified Surveys, NAFO Division 3Ps, 22 Nov to 2 Dec 1999.

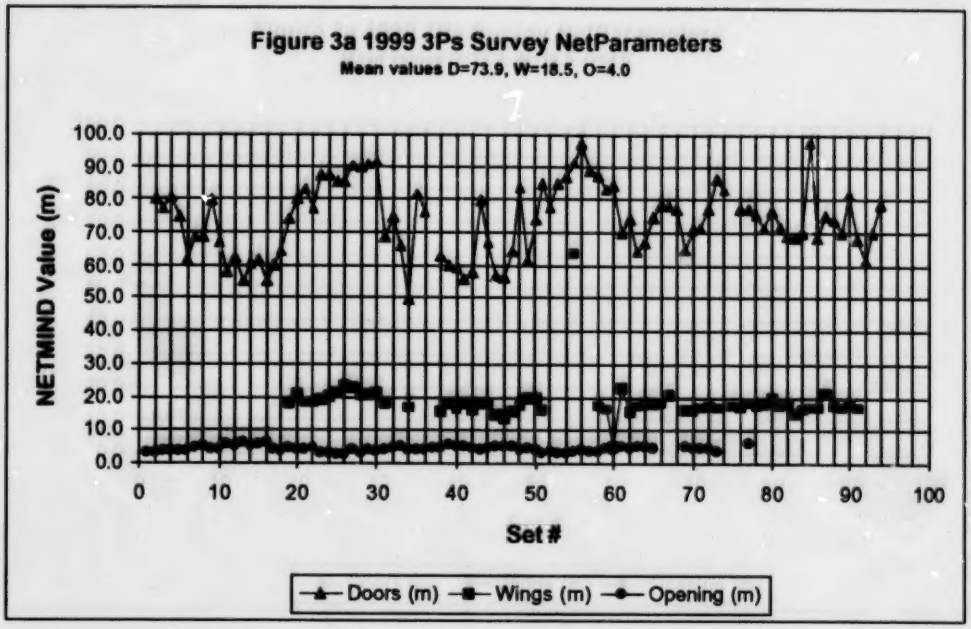
Figure 3a 1999 3Ps Survey NetParameters
Mean values D=73.9, W=18.5, O=4.0
NETMIND Value (m)
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0
10
20
30
40
50
60
70
80
90
100
Set #
Doors (m)
Wings (m)
Opening (m)

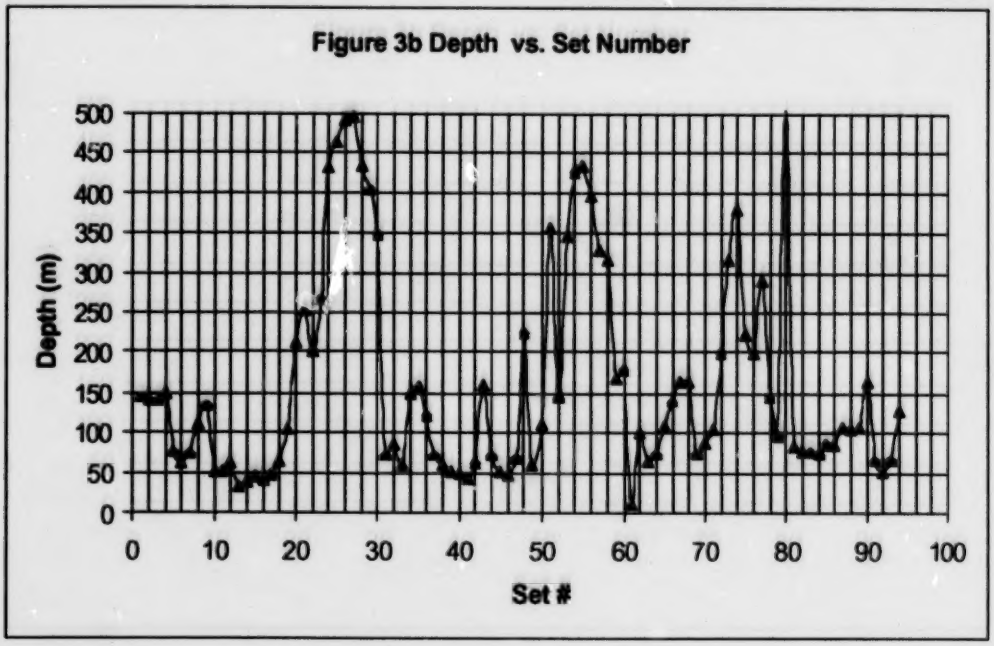
Figure 3b Depth vs. Set Number
Depth (m)
500
450
400
350
300
250
200
150
100
50
0
0
10
20
30
40
50
60
70
80
90
100
Set #

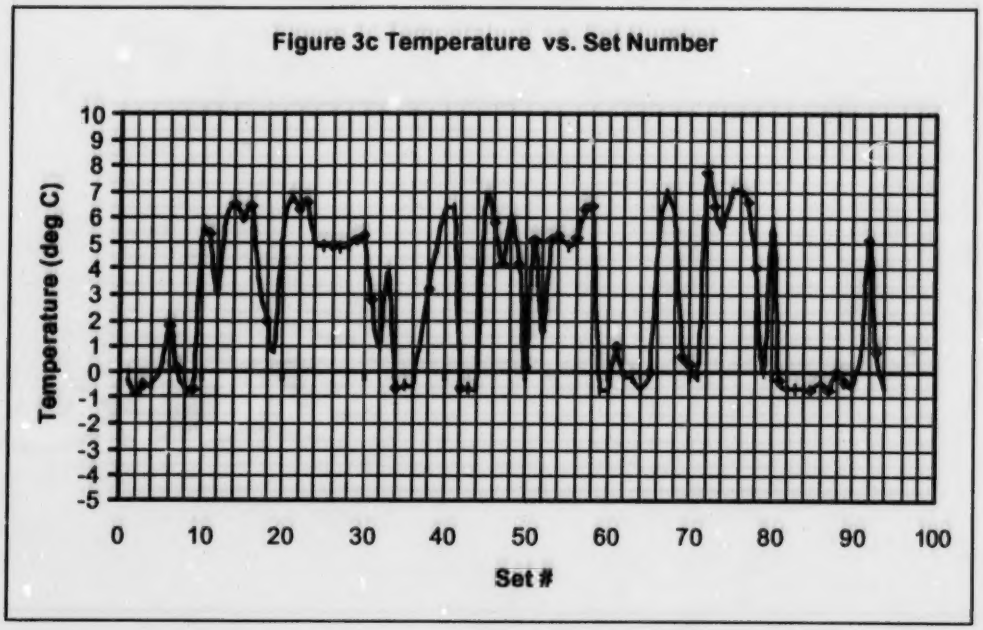
Figure 3c Temperature vs. Set Number
Temperature (deg C)
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
0
10
20
30
40
50
60
70
80
90
100
Set #

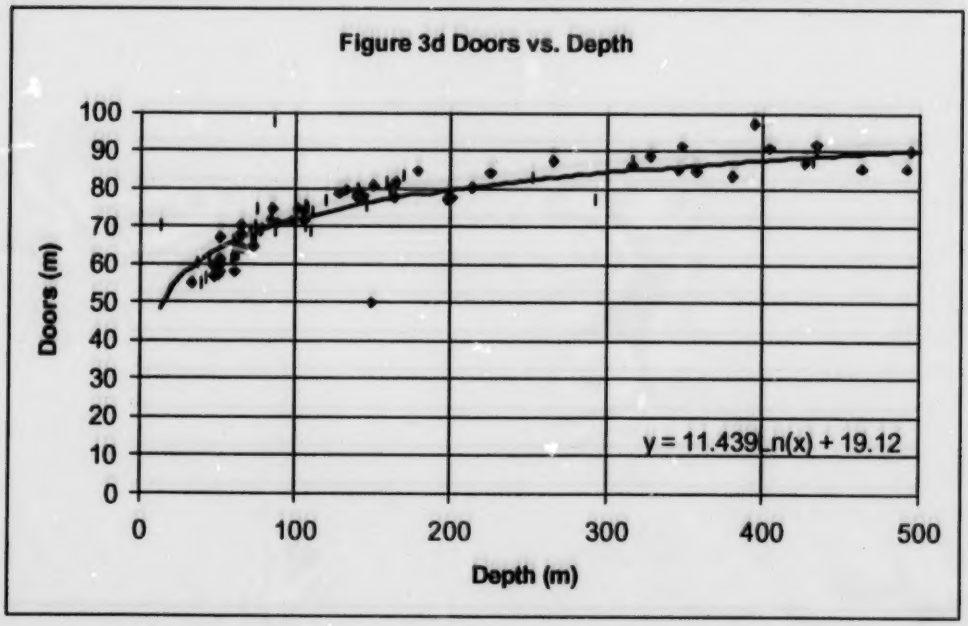
Figure 3d Doors vs. Depth
Doors (m)
100
90
80
70
60
50
40
30
20
10
0
0
100
200
300
400
500
Depth (m)
y = 11.439 Ln(x) + 19.12

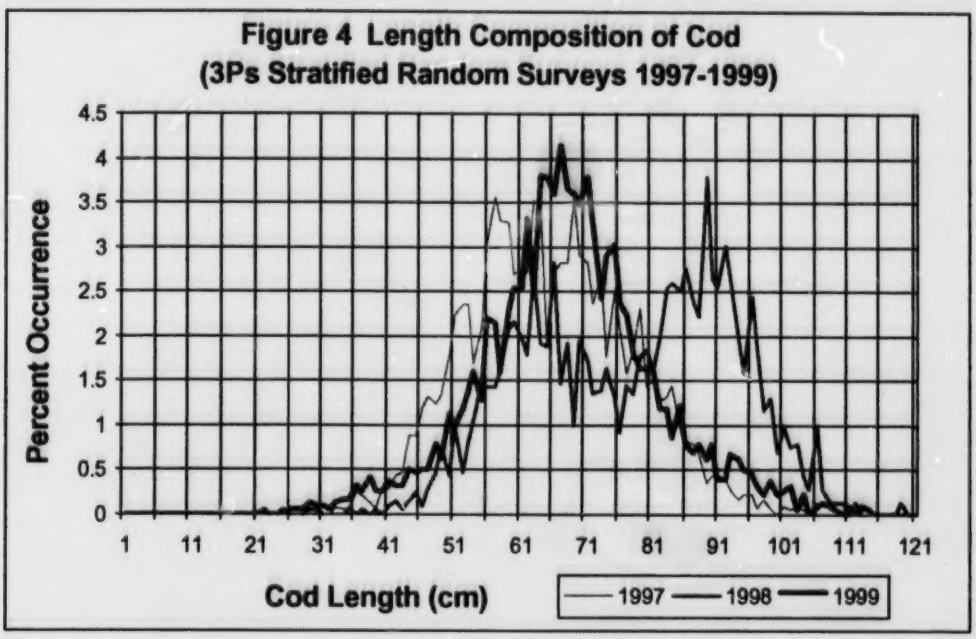
Figure 4 Length Composition of Cod
(3Ps Stratified Random Surveys 1997-1999)
Percent Occurrence
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1
11
21
31
41
51
61
71
81
91
101
111
121
Cod Length (cm)
1997
1998
1999

Figure 5a Cod Age-Length Composition
3Ps 1999 (551 samples)

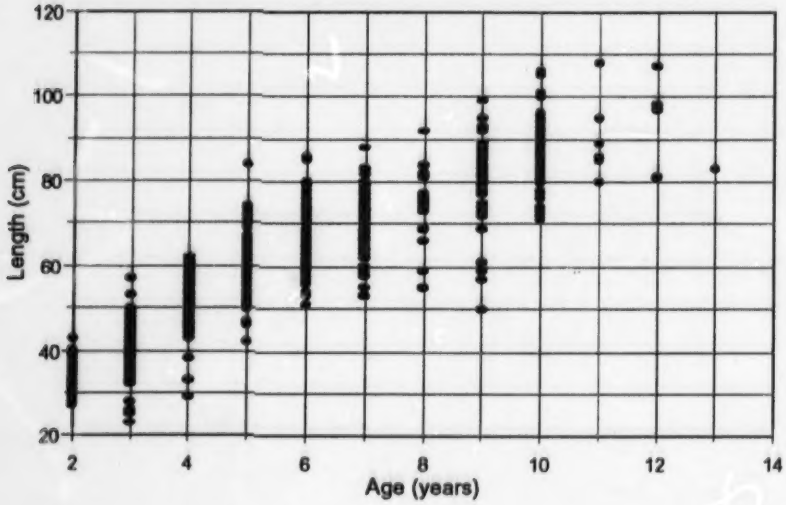

Figure 5b Age Composition of Cod
3Ps Sampled Cod

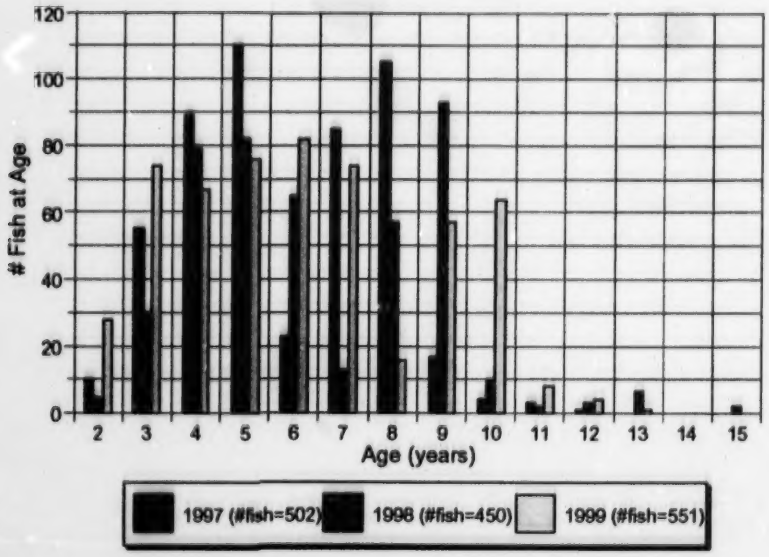

Figure 5c Age Composition of Cod
3Ps Sampled Cod

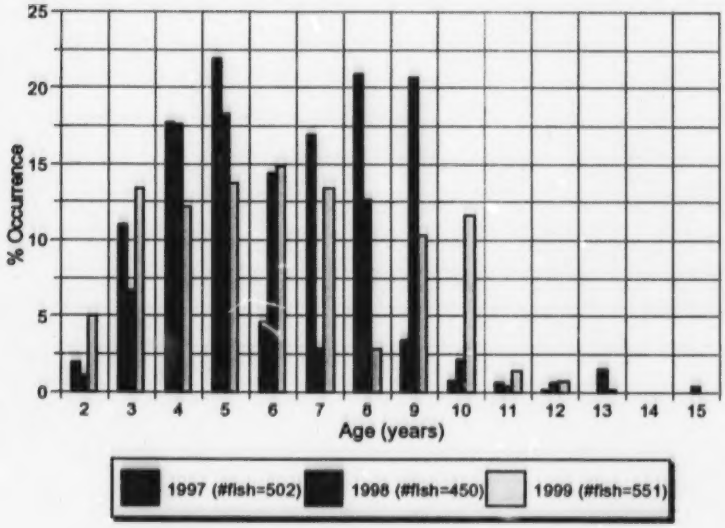

Figure 6b Age Composition of Cod (3Ps)
Estimated % of Total Mean #s per tow

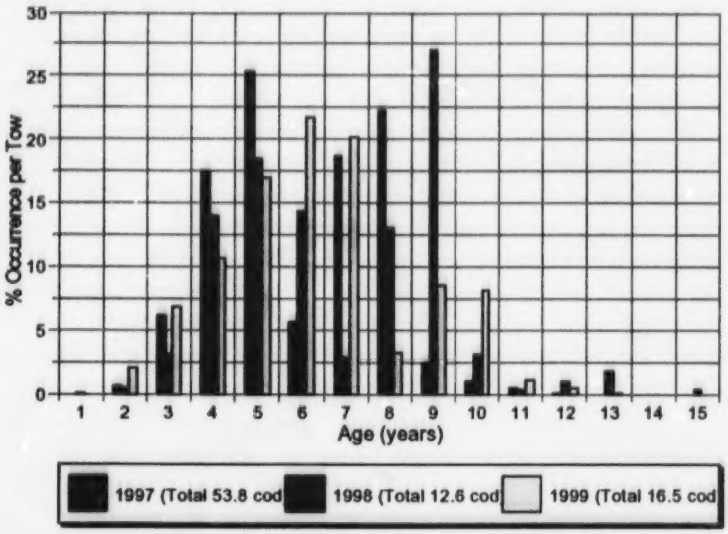

Figure 7a Year Class Composition
3Ps Cod Estimated Mean #s per tow

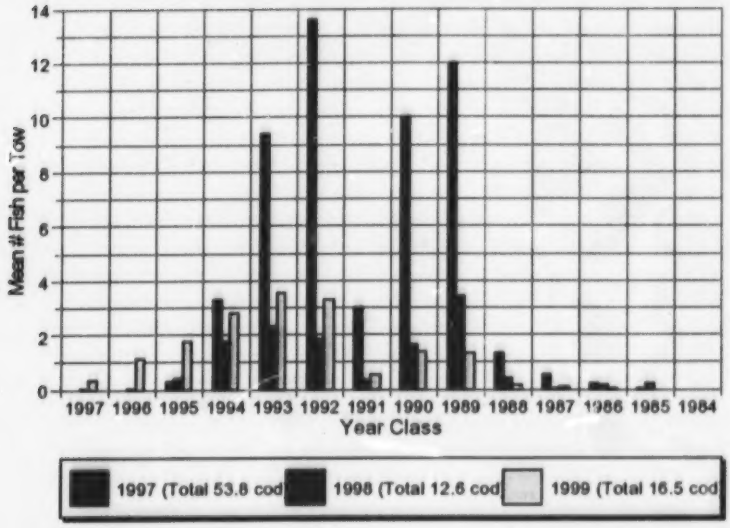

Figure 7b Year Class Composition
3Ps Cod Estimated % Total Mean #s/ tow